

In the Matter of:

***State of Oklahoma***  
***v.***  
***Tyson Foods Inc. et al.***

Case no. 05-CV-329-GFK-PJC

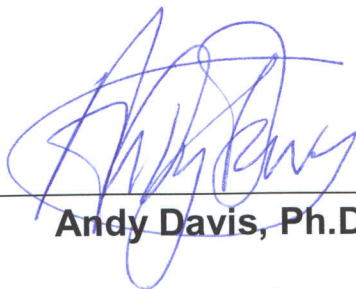
**Expert Report**

April 3, 2009

Prepared for:

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## Summary of Opinions

1. I obtained the State database for the Illinois River watershed (IRW) and evaluated the surface water and sediment data upstream and downstream of the Cargill locations. The purpose of this evaluation did not include determining the definitive causes of elevated phosphorus levels in the IRW, if any. Rather, the purpose was to determine whether State data show if specific Cargill locations were responsible for any elevated phosphorus levels in Lake Tenkiller and/or the IRW.
2. The data provided to me do not demonstrate that individual Cargill contract-grower or Cargill-owned (collectively, Cargill) locations have affected adjacent receiving waters.
3. There have been no site-by-site sampling campaigns and no loading computations to demonstrate that individual Cargill locations have affected surface waters.
4. Based on my analysis, I distinguished five classes of Cargill locations:
  - 7 sites where there is no demonstrable effect on potentially receiving waters because there is a substantial distance (at least four miles) between the site and the nearest environmental data, and thus there are no relevant sample data available: OK-01, OK-03, AR-09, AR-10, AR-11, AR-20, and AR-25;
  - 9 sites where there appears to be no downgradient effect based on the relevant surface water sample data and/or sediment phosphorous (P) baseline data: OK-05, OK-06, AR-07, AR-18, AR-21, AR-23, AR-26, AR-32, and AR-33;
  - 2 sites where P concentrations in the relevant surface water and/or sediment sample data decrease from upstream to downstream of the site, showing no effect on the potentially receiving water: AR-34, and AR-35;
  - 17 sites where P concentrations in the relevant samples are above baseline for sediment samples or elevated above screening level for surface water samples; the sample data reflect natural processes and/or anthropogenic activities contributing P between the Cargill location and the relevant sample location: OK-02, OK-04, AR-08, AR-12, AR-13, AR-14, AR-15, AR-16, AR-17, AR-19, AR-22, AR-24, AR-27, AR-28, AR-29, AR-30, and AR-31; and
  - 0 sites where P concentrations appear affected by Cargill locations.

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- 1 Histogram for sediment P showing bimodal population distribution.**
- 2 Quantile-quantile plot showing population break at 460 mg/kg P.**

## Acronyms and Abbreviations

EPA	US Environmental Protection Agency
GeoSHIP	Geological Site Holistic Interpretation Program
GPS	global positioning system
IRW	Illinois River watershed
KML	Keyhole Markup Language
P	phosphorous

## 1 Introduction

I have been retained by the law firm of Faegre & Benson LLP, on behalf of Cargill Inc. and Cargill Turkey Production LLC, to provide opinions in the matter of the *State of Oklahoma v. Tyson Foods Inc. et al.* Specifically, I was asked to evaluate the evidence provided by the State to see if the State has demonstrated that any of the 35 Cargill contract-grower or Cargill-owned (collectively, Cargill) locations had affected waters or surface water sediment in adjacent waters of Arkansas and Oklahoma.

## 2 Data Acquisition and Analysis

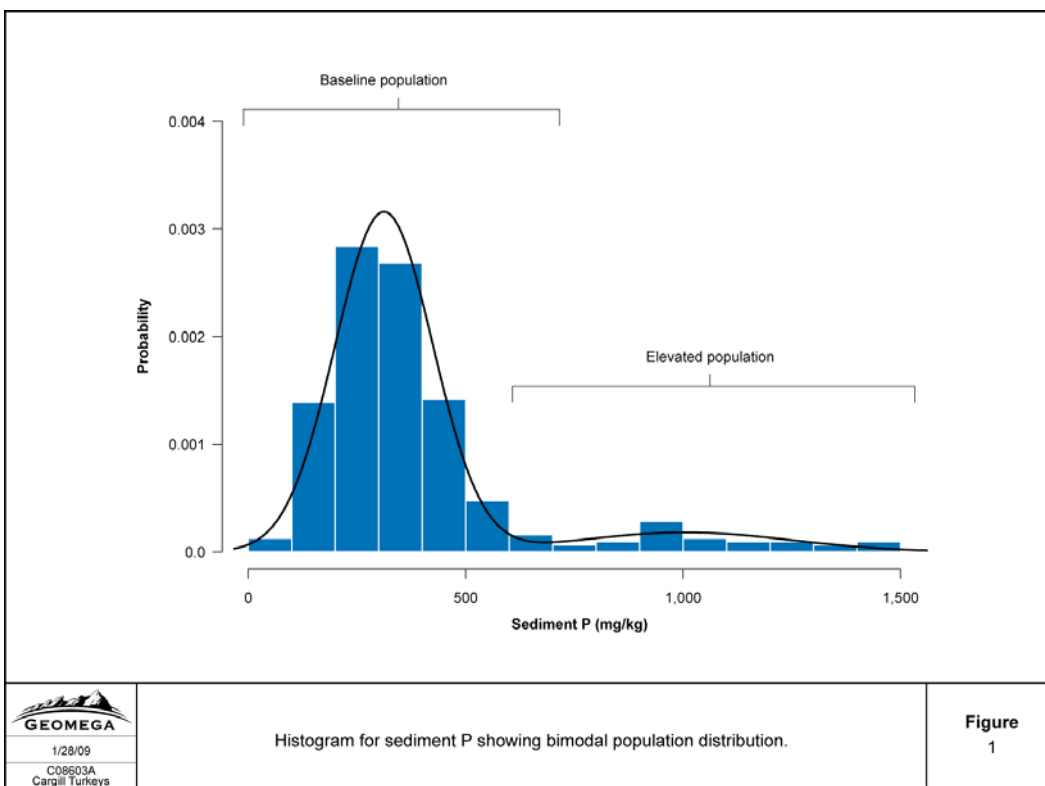
Geomega analyzed the data provided by the State in an Access database. Geomega used the analytical results as provided by the State and did not add new data from outside sources, did not collect new data, and did not assess or endorse the quality of the State data, fieldwork, or sampling protocols. The data set contains 94,370 records for 19 different matrices, of which 3,653 were excluded from the analysis either because there was no given result or because units were not provided. The majority of the database (over 60,125 records) is surface water data, with groundwater (5,979 records), soil (6,329 records), and sediment (9,995 records) also represented. The database contains information on 300 different parameters.

The 35 Cargill locations were provided by Cargill Turkey Production, and the property boundaries were obtained from the applicable counties as shapefiles. These were converted into Keyhole Markup Language (KML) files and imported into Google Earth. Other data were queried from the aforementioned database and converted into KML files. The area covers Delaware, Cherokee, and Adair counties in northeastern Oklahoma, and Washington and Benton counties in northwestern Arkansas.

I reviewed soil, groundwater, sediment, and surface water data (where collected) in the vicinity of the Cargill locations to evaluate whether the State's data show that P in sediments and surface water beneath the confluence with a potential receiving water (1) exceeded upstream concentrations, and (2) is attributable to a local Cargill location.

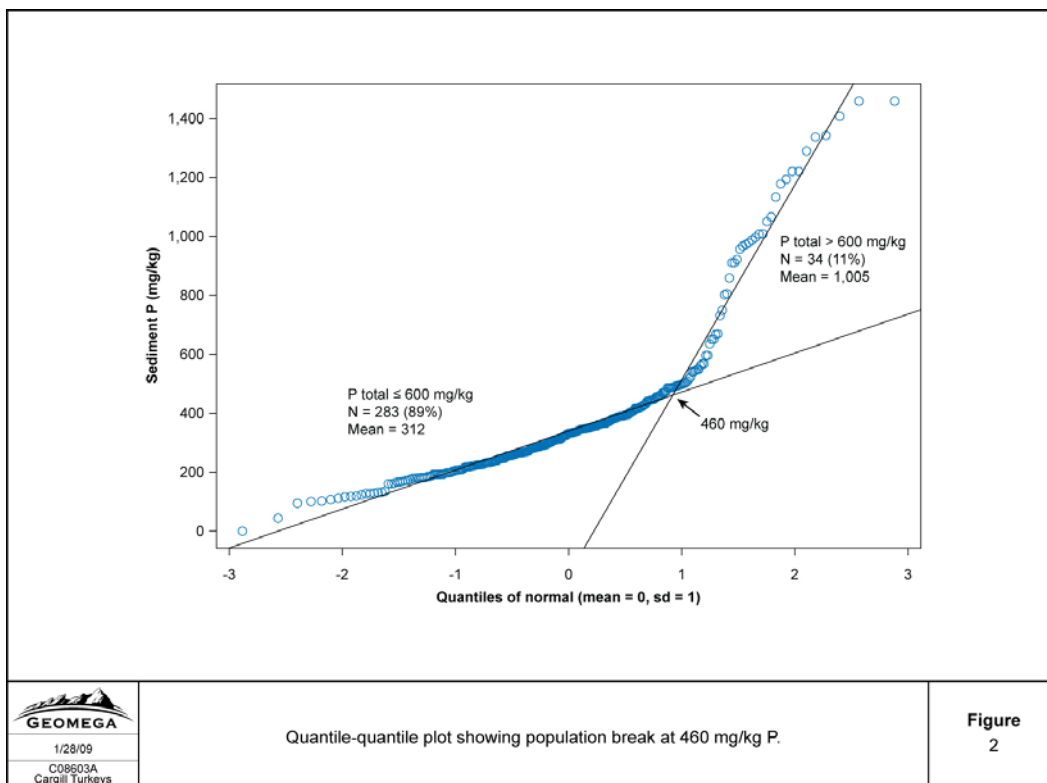
## 2.1 Sediment Baseline Phosphorous Concentrations

The Environmental Statistics Module of the S-Plus statistics software package was used to test the hypothesis that there were separate populations of phosphorous (P) in the 317 sediment samples and that specifically, there is a baseline population distinct from affected sediments. Plotting the histogram of sediment P (Figure 1), it is clear that there are two populations, separated at ~600 mg/kg. Analyzing the groups separately indicates that the low concentration group comprises 89% of the population, with a mean concentration of 312 mg/kg; the high concentration group comprises 11% of the population, with a mean of 1,005 mg/kg.





A quantile-quantile plot constructed from the data clearly indicates two populations (Figure 2). Best-fit lines were calculated for the two groups and added to the plot. The lines intersect at a concentration (y-axis value) of 460 mg/kg. Concentrations below 460 mg/kg are attributed to baseline conditions. Between 460 mg/kg and 600 mg/kg, the provenance (baseline or elevated) is unclear. Above 600 mg/kg, the sediment is considered to be elevated, but the State has collected no data to identify the source(s). The sources could include but are not limited to, septic systems, campgrounds, waste water treatment plants, cattle, poultry, urban runoff (fertilized yards and golf courses, for example), and runoff from agricultural fields where phosphorous-containing pesticides and commercial fertilizer have been applied. Concentrations above 460 mg/kg do not necessarily indicate a problem; however, I used this value as a conservative screening criterion to identify sample concentrations above baseline. It should be noted that 460 mg/kg is not a regulatory standard.



J:\Cargill\Expert Report 2009\PP Q-Q Plot.xls

## 2.2 Surface Water

The surface water population does not show the same bimodal distribution as in the sediment data set; therefore, a statistical analysis could not be used to define a baseline population. The Title 785 Oklahoma Water Resources Board standard of 37 µg/L (OWRB 2008) is an inappropriate standard, because it is based on a 30-day mean and is inconsistent with the sampling strategy employed by the State. Each sample result reported by the State is collected on a single date at a single location. Many of the surface water values, which are reported as mg/L in the State database, contained only two significant figures (for example, a 0.037 mg/L value would be rounded up to 0.04 mg/L). Therefore, for purposes of this report, I used a value of 0.04 mg/L as a screening level to distinguish a threshold between baseline and elevated populations.

## 2.3 Data Analysis

The data provided by the State have not been collected adequately, in a systematic manner, to convey the spatial and temporal variations in the Illinois River watershed (IRW). Each phosphorus sample was collected in a point location that has an integrated, collective value derived potentially from a variety of sources. Given the methodology employed by the State, the sampling locations and time of sample collection cannot and do not demonstrate a causal connection between the samples and the Cargill locations.

There are also other intervening anthropogenic sources that potentially contribute P to the receiving waters. However, the State has provided no data that connects a potential source to a potential receptor (the nearest receiving water) in the vicinity of the Cargill locations. These sources, which have not been quantified by the State, include but are not limited to septic systems, campgrounds, waste water treatment plants, cattle, poultry, urban runoff (fertilized yards and golf courses, for example), and runoff from agricultural fields where phosphorous-containing pesticides and commercial fertilizer have been applied.

### 3 Individual Cargill Location Data Analyses







This section presents a site-by-site analysis of the Cargill locations and available data. The methods and screening approach were as follows:

1. Located the 35 Cargill locations, on Google Earth using global positioning system (GPS) coordinates of longitude and latitude.
2. Analyzed State sample data and locations focusing on a two-mile radius around each site and considering data beyond the two-mile radius. State data contained GPS coordinates of longitude and latitude for each sample location.
3. Superimposed State sample data and locations onto Google Earth using the GPS coordinates provided by the State.
4. Developed site-specific conceptual models for 35 Cargill locations.
5. Identified the location of proximal water/sediment/groundwater/soil/edge-of-field samples above and below Cargill locations.
6. For Cargill locations in close proximity to waterways, compared incremental P concentrations in surface water and sediments upstream vs. downstream.
7. For Cargill locations not in close proximity to waterways, compared incremental P concentrations in surface water and sediments above and below the confluence between the drainage and the higher-order stream.
8. Noted other anthropogenic features that potentially contribute P to the watershed in close proximity to Cargill locations, or between the Cargill locations and sample sites.
9. Classified the Cargill locations into five categories, as follows:
  - sites where there is no demonstrable effect on potentially receiving waters because there is a substantial distance (at least four miles) between the site and the nearest environmental data, and thus there are no relevant data available;
  - sites where there appears to be no downgradient effect based on the relevant surface water sample data and/or sediment phosphorous (P) baseline data;
  - sites where P concentrations in the relevant surface water and/or sediment sample data decrease from upstream to downstream of the site, showing no effect on the potentially receiving water;
  - sites where P concentrations in the relevant samples are above baseline for sediment samples or above screening level for surface water samples; the sample data reflect natural processes and/or anthropogenic activities contributing P between the Cargill location and the relevant sample location; and

- sites where P concentrations appear affected by Cargill locations.

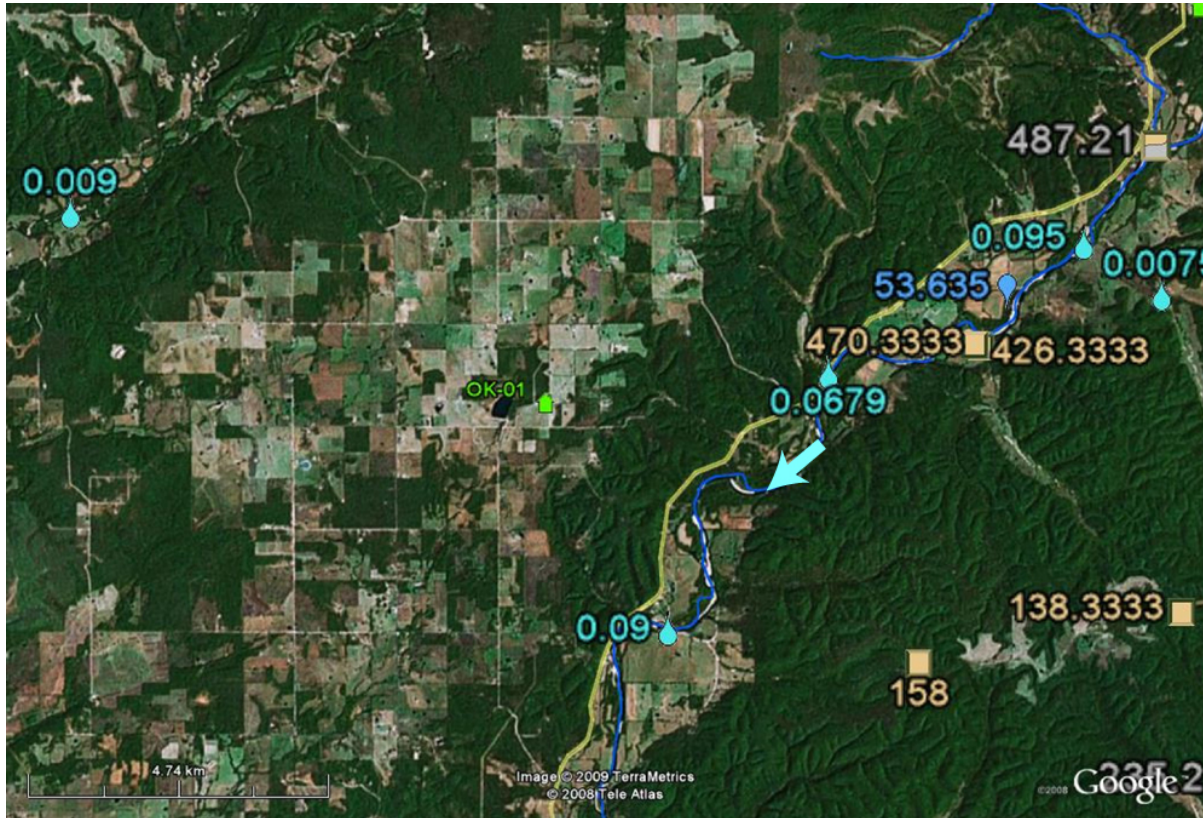
10. Compiled results using spatial images generated by the Geological Site Holistic Interpretation Program (GeoSHIP) and Google Earth.

Each picture in this section of the report shows the location of any available surface water data (aqua teardrop symbol), groundwater data (inverted blue teardrop symbol), sediment data (split light brown/gray square symbol), soil data (light brown square symbol), and Cargill location (green house symbol with location number by state).

<b>KML Icon Definitions</b>	
	Cargill locations (OK = Oklahoma; AR = Arkansas)
	Groundwater sample locations (mg/L)
	Surface water sample locations (mg/L)
	Sediment sample locations (mg/kg)
	Soil sample locations (mg/kg)
	Direction of stream flow

### 3.1 Site OK-01

Owner: G. Fisher; Long -94.931750 Lat 36.063483

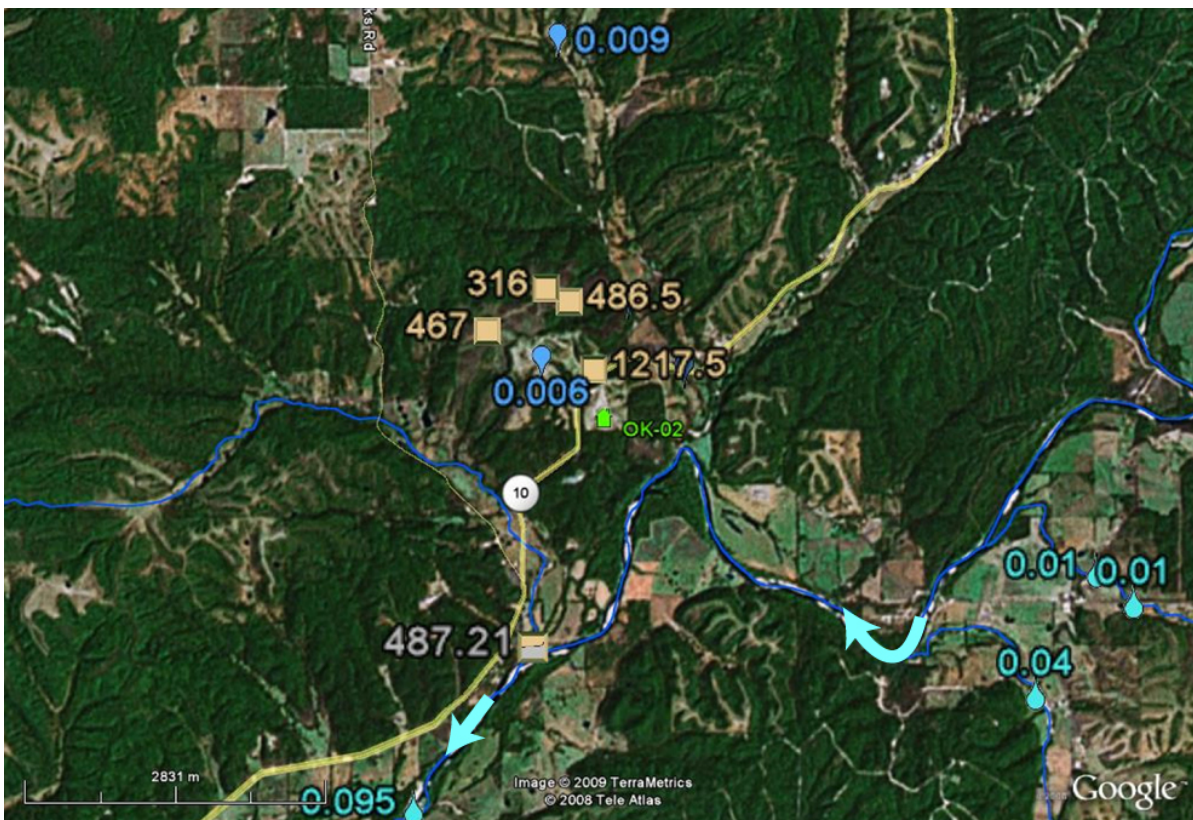


- Available Data and Analysis:** There are no groundwater, soil, sediment, or surface water samples that have been collected within two miles of site OK-01. Surface water moves from OK-01 to the southwest. Sediment and surface water samples have been collected upgradient, east of the site. The sediment sample, 426 mg/kg P, is less than the 460 mg/kg P baseline criterion (Figure 1). Surface water P increases from 0.068 mg/L to 0.09 mg/L, but the samples, collected more than two miles from OK-01, were not collected along the surface water flow path from the site.
- Site Effect on the Watershed:** Based on the available data and analysis, there is no evidence that site OK-01 has affected receiving waters or sediments of the IRW.



### 3.2 Site OK-02

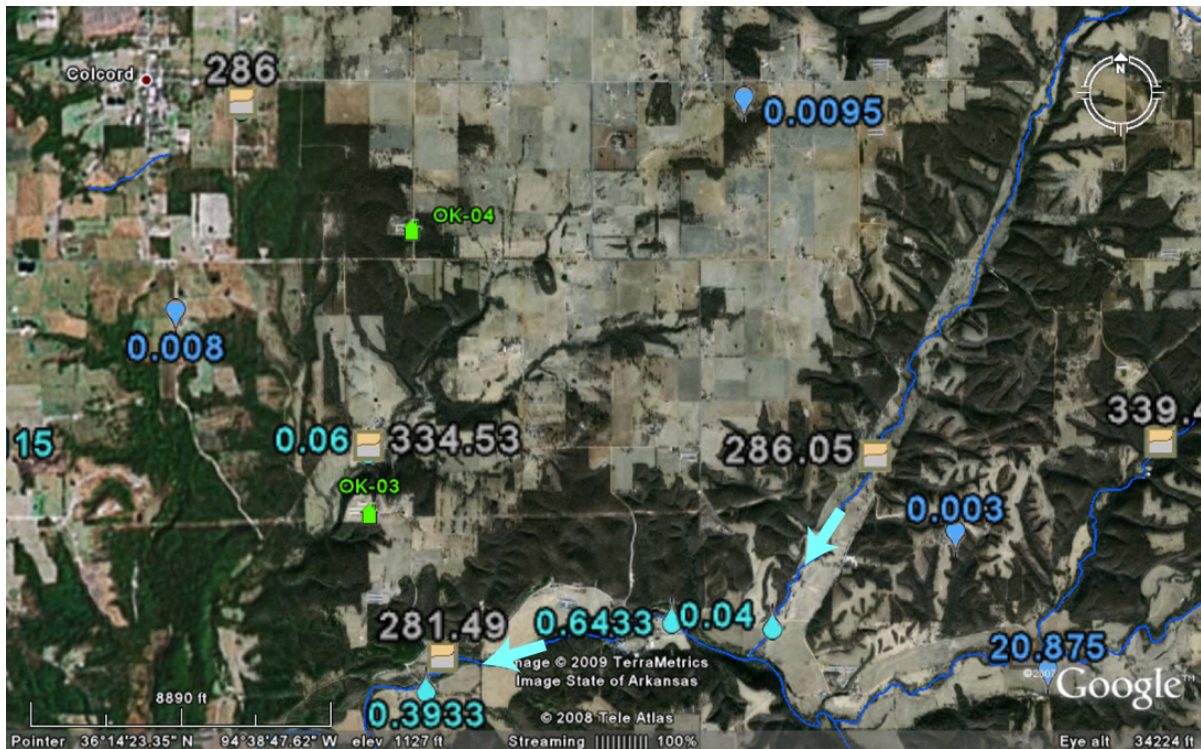
Owner: R. Schwabe; Long -94.817583 Lat 36.119233



- Available Data and Analysis:** No surface water samples have been collected within two miles of the site. Groundwater (0.006 mg/L P) and soil (ranging from 316 to 485 mg/kg P) samples have been collected at site OK-02. A sediment sample (487 mg/kg P) is located within two miles and downgradient from site OK-02, and is slightly above the 460 mg/kg P baseline. A surface water sample (0.095 mg/L P) was collected more than 2.5 miles downstream from OK-02. There are other potential anthropogenic P sources between OK-02 and this surface water sample. See Appendix B.
- Site Effect on the Watershed:** Based on the available data and analysis, there is no evidence that site OK-02 has affected receiving waters or sediments of the IRW.

### 3.3 Site OK-03

Owner: Mitchell; Long -94.670533 Lat 36.228883

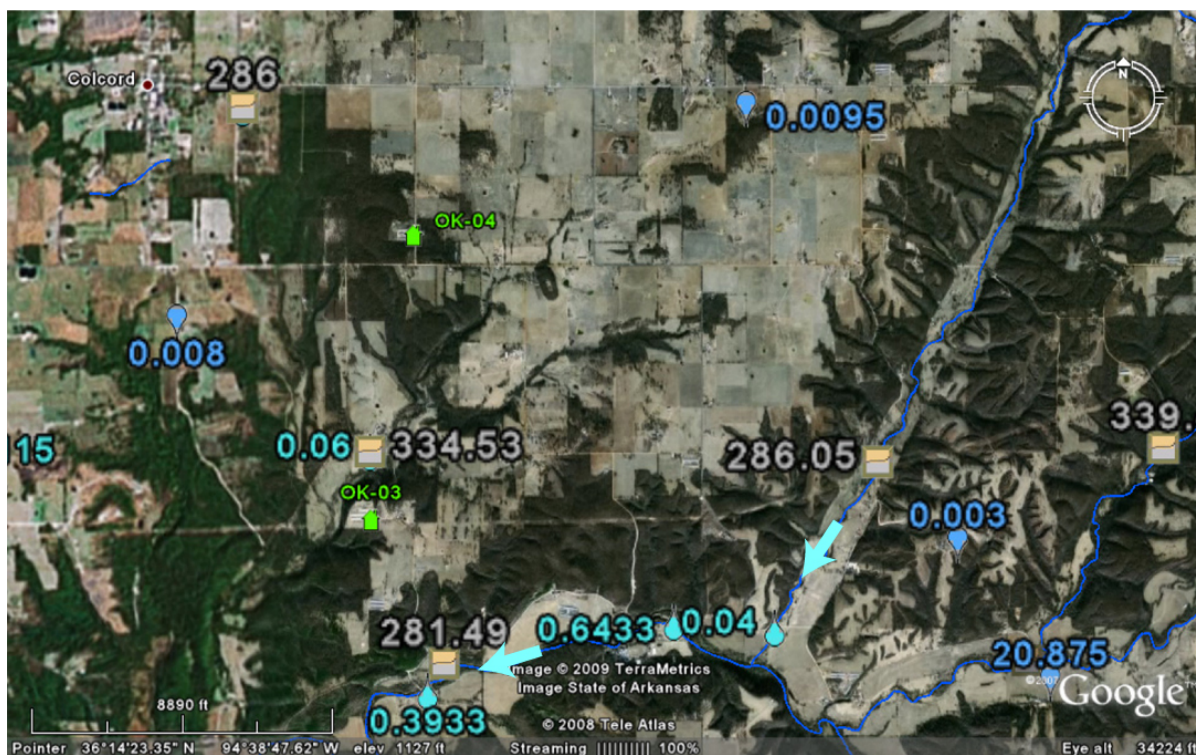


- **Available Data and Analysis:** Groundwater (0.008 mg/L P), co-located upstream sediment (334 mg/kg P), and surface water (0.06 mg/L P) samples collected within 1.5 and 0.5 miles, respectively, of site OK-03 show no apparent effects. There have been no soil samples collected on-site. The proximal sediment sample (282 mg/kg P) and co-located surface water (0.39 mg/L P) are located in a different drainage to OK-03.
- **Site Effect on the Watershed:** Based on the available data and analysis, there is no evidence that site OK-03 has affected receiving waters or sediments of the IRW.
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### 3.4 Site OK-04

Owner: Hurt; Long -94.666216 Lat 36.251950

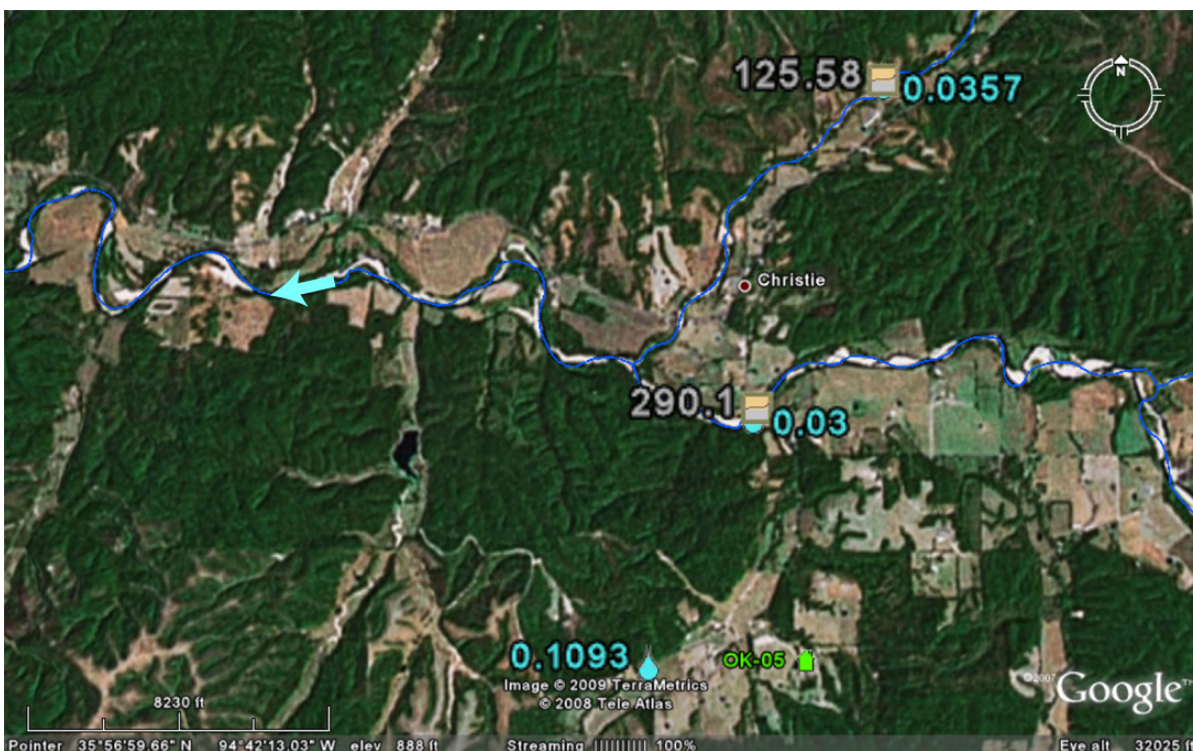


- Available Data and Analysis:** Groundwater (0.008 mg/L P) and sediment (334 mg/kg P) samples collected downgradient from site OK-04 show no apparent effects on the environment from this site. No soil samples have been collected on-site. A surface water sample (0.06 mg/L P) was collected downstream from OK-04. There are other potential anthropogenic P sources between OK-04 and this surface water sample. See Appendix B.
- Site Effect on the Watershed:** Based on the available data and analysis, this site has not affected receiving waters or sediments of the IRW.



### 3.5 Site OK-05

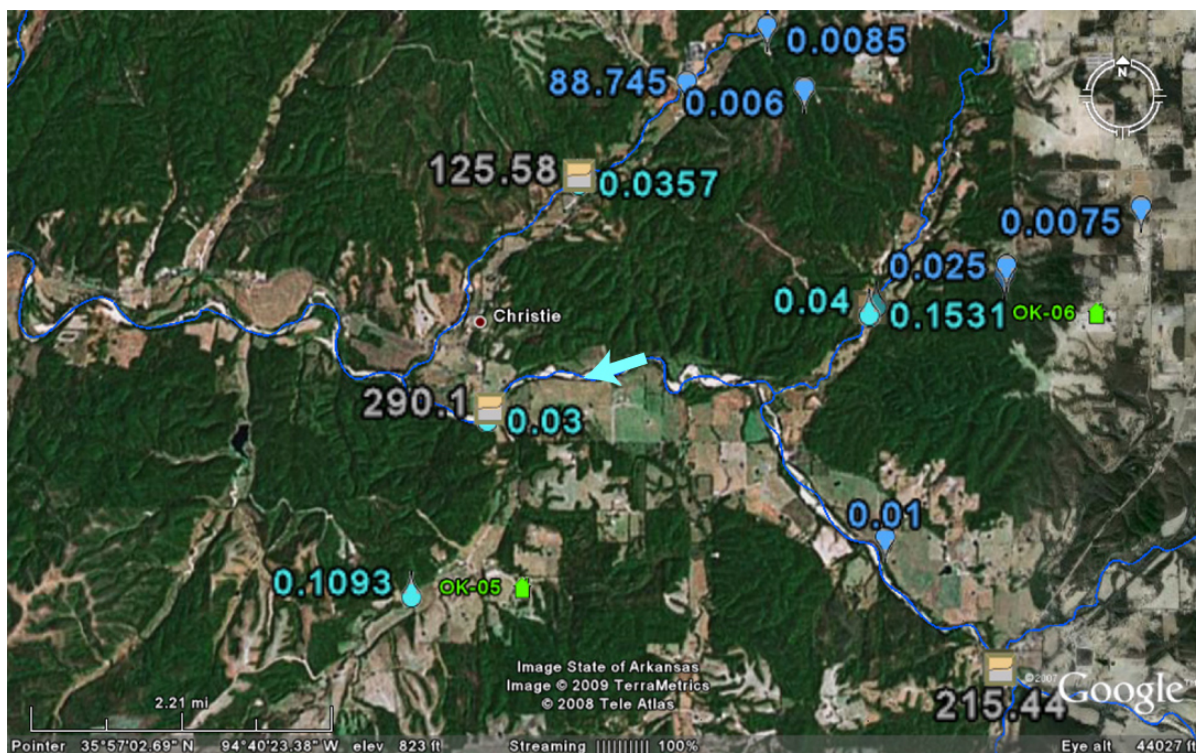
Owner: E. Doyle; Long -94.684616 Lat 35.928566



- Available Data and Analysis:** Sediment (290 mg/kg P) and surface water (0.03 mg/L P) samples collected downgradient from site OK-05 show no apparent effects. Groundwater and soil samples have not been collected on-site or downgradient within two miles of the site. One surface water sample (0.109 mg/L P) was collected upgradient within two miles of the site, but not along a transport path from OK-05. The downgradient sediment sample of 290 mg/kg P is less than the 460 mg/kg P baseline cutoff.
- Site Effect on the Watershed:** Based on the available data and analysis, this site has not affected receiving waters or sediments of the IRW.

### 3.6 Site OK-06

Owner: C. Masters; Long -94.608650 Lat 35.958250



- Available Data and Analysis:** Groundwater (0.01 and 0.015 mg/L P) and surface water (0.04 mg/L P) samples collected adjacent to site OK-06 (~0.5 miles) show no apparent effects on the environment from this site. Soil samples have not been collected on-site. The closest downstream sediment (290 mg/kg P) and co-located surface water (0.03 mg/L) samples were collected about nine miles downstream from the site.
- Site Effect on the Watershed:** Based on the available data analysis, this site has not affected receiving waters or sediments of the IRW.